

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re Application of:

Mikio KATSUBE et al.

Serial No.: 09/066,168

Filed : April 24, 1998

For : PERMSELECTIVE MEMBRANE MODULE



Group Art Unit: 1723

Examiner: Ana FORTUNA

DECLARATION

Honorable Commissioner of Patents and Trademarks

Washington, D.C. 20231

Sir :

I, Mikio KATSUBE, of 1-1, Nadamachi, Iwakuni-shi, Yamaguchi-ken, Japan, hereby declare:

1) That I graduated from Yamaguchi University, Faculty of Chemical Engineering, Department of Engineering in March, 1990. In March, 1992, I received a master's degree in Chemical Engineering from Yamaguchi University. In April, 1992, I joined Toyo Boseki Kabushiki Kaisha, the assignee of the above-identified application, where I have been engaged in research and development of RO (Reverse Osmosis) membranes and modules, and I am now a researcher in the Quality Assurance Section at Iwakuni Membrane Plant of Toyo Boseki Kabushiki Kaisha.

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2) That I am one of the inventors of the instant invention.

3) That the experiment shown below was carried out under my general direction and supervision.

Experiment 1

Experiment 1 was conducted to evaluate the separation performance of the hollow fiber membrane module 1 of the first embodiment (see Fig. 1 of the patent application). The cylindrical pressure vessel 2 has a length of 2789 mm.

In Experiment 1, a brackish water was used as feed liquid. Composition of the brackish water is shown in Table 1. The pressure applied was 30 kg/cm², and the recovery ratio was 75%. The test was carried out with modules which varied in the distance d between the end of the cylindrical pressure vessel 2 and the centerline of the discharge outlet 13. Table 2 below shows the test results.

Table 1

Analysis Items	Results
Cl ⁻	5.7 ppm as ion
SO ₄ ²⁻	7.4 ppm as ion
SiO ₂	12.9 ppm
Hardness	31 ppm as CaCO ₃
pH	6.8
Water Temperature	10°C

Table 2

Module No.	d (m)	Permeated Flux (m ³ /day)	Salt Rejection (%)	Scale Deposition	Sealing Performance
1	0.05	—	—	—	Leakage
2	0.1	83	98	None	No leakage
3	0.2	83	98	None	No leakage
4	0.3	83	97	None	No leakage
5	0.4	83	97	None	No leakage
6	0.6	83	96	None	No leakage
7	0.8	83	90	Soft	No leakage
8	1.2	75	82	Hard	No leakage

As seen from the results in Table 2, in the cases of Modules 2-6, adequate amounts of permeated flux were obtained, salt rejections were high, and no deposition of scales was found. The data in Table 2 indicate Modules 2-6 can achieve high performance in desalination.

In contrast, Module 1 had a defect of leakage of the feed liquid due to poor sealing of the tube seat ring holding the opening end of the hollow fiber membrane.

In the case of Module 7, a soft scale deposited, and the salt rejection was significantly lower than that of Modules 2-6.

In the case of Module 8, a hard scale deposited, the salt rejection was lower and the permeated flux was smaller than those of Module 7.

Conclusion

Considering the results of Experiment 1 as described above, it is essential to position the discharge outlet port so that the distance d is in the range of $0.1 \text{ m} \leq d \leq 0.6 \text{ m}$.

I, the undersigned, declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: December 17, 1999

Mikio Katsube

Mikio KATSUBE